

Engineering Design File

Project No. 23415

Screening-Level Ecological Risk Assessment of the Engineering Test Reactor and Materials Testing Reactor Removal Alternatives

**Idaho
Cleanup
Project**

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5. Summary: <p><u>Problem Statement:</u> CH2M-WG Idaho, LLC (CWI) is in the process of performing decontamination and decommissioning of the Engineering Test Reactor (ETR) and Materials Testing Reactor (MTR) at the Reactor Technology Complex (RTC) (formerly the Test Reactor Area) on the Idaho National Laboratory. This Engineering Design File provides screening-level ecological risk assessment for the two projects.</p> <p><u>Conclusions:</u> The screening for radionuclides indicates that Co-60 and Ni-63 exceed ecologically based screening levels for Alternative 2 at the ETR and Co-60 for Alternative 2 at the MTR. Nonradionuclide concentrations exceed ecologically based screening levels for Alternative 4 at either location. Chromium and copper for both alternatives at the ETR and MTR exceeded hazard indices of 10. However, the assumptions made in the development of the nonradiological contaminant inventories were reviewed. For conservatism, the piping, wiring, stainless steel, and utility systems were included in the source-term development throughout the structures to a depth of 38 ft below grade (EDF-6225; EDF-6244). The inclusion of these metals in a non-bioavailable form in the overall soil concentration in the 10-ft depth is a highly conservative assumption. Therefore, it was concluded that it is unlikely that they would pose a risk to ecological receptors at a population level. The nonradionuclides were eliminated as a concern for all alternatives.</p>				
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Screening-Level Ecological Risk Assessment of the Engineering Test Reactor and Materials Testing Reactor Removal Alternatives

1. INTRODUCTION

This Engineering Design File (EDF) presents the screening ecological risk assessment performed in support of the removal of the Engineering Test Reactor (ETR) and Materials Testing Reactor (MTR) at the Reactor Technology Complex, formerly the Test Reactor Area. The risk assessment supports the two removal alternatives described below:

- **Alternative 2:** Reactor vessels are assumed to be grouted in place and the reactor buildings are removed to ground level. The contaminant inventory in the vessels and in the reactor buildings below grade is used in the risk assessment.
- **Alternative 4:** The reactor vessels, and therefore the vessels' contaminant inventory, are removed and disposed of elsewhere, and the reactor buildings are removed to ground level. Therefore, for Alternative 4, the only contaminant inventory remaining is that in the reactor buildings below grade.

Belowgrade portions of the reactor buildings will be grouted in place for both alternatives. As with the human health risk assessment (EDF-6482), this assessment only evaluates contaminants in the footprints of the ETR and MTR complexes and does not consider soils and piping exterior to the footprints. Risks from contamination that might be left in place within the ETR and MTR complexes' footprints after the removal action were evaluated by considering a worst-case contaminant source term and exposure scenario. It is assumed that any contamination remaining after removal is mixed uniformly in the top 10 ft (3.05 m) of soil. Alternative 2 (reactor vessels left in place) assumes that the remaining contamination will be grouted in place for 90 years and that the contamination will be released from the grout at the end of this period. Risks were evaluated for two alternative removal actions.

2. RISK APPROACH

The screening ecological risk assessment followed the approach presented in the *Guidance Manual for Conducting Screening Level Ecological Risk Assessments at the INEL* (VanHorn, Hampton, and Morris 1995) and documented in the *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Groups 6 and 10 Operable Unit 10-04* (DOE-ID 2001) and the *Risk-Based Screening and Assessment Approach for Waste Area Group 1 Soils* (Van Horn and Stacey 2004). Contaminants of potential concern that exceeded screening were further evaluated. The initial screening process is discussed in the following subsections.

2.1 Background Comparison

As performed in the human health chemical screening, the first step in the ecological screening process is to distinguish potential contamination associated with the site from naturally occurring background conditions. The comparison is primarily conducted using the composite background values from the *Background Dose Equivalent Rates and Surficial Soil Metal and Radionuclide Concentrations for the Idaho National Engineering Laboratory* (Rood, Harris, and White 1996) or from other sources, as identified.

2.2 Essential Nutrient Identification

Step 2 of the ecological screening process is an essential nutrient analysis. As performed in the human health risk assessment, site chemicals that are considered essential nutrients are not evaluated further unless the concentration is greatly in excess of the background value (10 times). The six metals routinely eliminated by this screening step are aluminum, calcium, iron, magnesium, potassium, and sodium (Cirone 1991).

2.3 Comparison of Maximum Concentration to Ecologically Based Screening Level

For the remaining chemicals, the third step in the ecological chemical screening process is to compare potential contaminants associated with the site with ecologically based screening levels (EBSLs) or U.S. Environmental Protection Agency (EPA) Region 4 ecological soil screening levels, as noted. If the maximum concentration for a given chemical is greater than or equal to the most conservative EBSL, then the chemical is retained for further evaluation. The EBSLs used for the screening are consistent with the Idaho National Laboratory (INL) -wide screening levels. Details for EBSL development and EBSL values are documented in Appendix D2 of the *Work Plan for Waste Area Groups 6 and 10 Operable Unit 10-04 Comprehensive Remedial Investigation/Feasibility Study* (DOE-ID 1999). New ecological soil screening levels provided in the new or updated chemical-specific documents from the EPA (<http://www.epa.gov/ecotox/ecossi/recent.htm>) were included for aluminium, antimony, arsenic, barium, beryllium, cadmium, chromium (no value is available for exposure to plants), cobalt, iron, lead, and vanadium.

3. INITIAL SCREENING OF RADIONUCLIDES

This ecological risk screening used the values provided by the “Streamlined Risk Assessment for D&D of the ETR and MTR Reactor Facilities” (EDF-6482). For radionuclides, the concentrations provided in Table A-3 of EDF-6482 were used. The initial screening tables are presented in Appendix A. A results summary for the initial screening of the radionuclides is presented in Table 1. Table 1 indicates that Co-60 for Alternative 2 at both locations and H-3 and Ni-63 for ETR Alternative 2 exceeded the screening levels.

Table 1. Results of radionuclide screening (2005 inventories from EDF-6482) against ecological soil screening levels.

Nuclide	ETR		MTR	
	Alternative 2	Alternative 4	Alternative 2	Alternative 4
Ac-227	No	No	No	No
Ag-108m	No	No	No	No
Ag-110m	No	No	No	No
Am-241	No	No	No	No
Am-243	No	No	No	No
Be-10	No	No	No	No
C-14	No	No	No	No
Ce-144	No	No	No	No
Cl-36	No	No	No	No

Table 1. (continued).

Nuclide	ETR		MTR	
	Alternative 2	Alternative 4	Alternative 2	Alternative 4
Cm-243	No	No	No	No
Cm-244	No	No	No	No
Cm-245	No	No	No	No
Cm-246	No	No	No	No
Cm-247	No	No	No	No
Cm-248	No	No	No	No
Co-60	Yes	No	Yes	No
Cs-134	No	No	No	No
Cs-137	No	No	No	No
Eu-152	No	No	No	No
Eu-154	No	No	No	No
Eu-155	No	No	No	No
Fe-55	No	No	No	No
H-3	Yes	No	No	No
I-129	No	No	No	No
Mn-54	No	No	No	No
Nb-94	No	No	No	No
Nb-95	No	No	No	No
Ni-59	No	No	No	No
Ni-63	Yes	No	No	No
Np-237	No	No	No	No
Pa-231	No	No	No	No
Pb-210	No	No	No	No
Pu-238	No	No	No	No
Pu-239	No	No	No	No
Pu-240	No	No	No	No
Pu-241	No	No	No	No
Pu-242	No	No	No	No
Pu-244	No	No	No	No
Ra-226	No	No	No	No
Ru-106	No	No	No	No
Sb-125	No	No	No	No
Sr-90	No	No	No	No
Tc-99	No	No	No	No
Th-228	No	No	No	No

Table 1. (continued).

Nuclide	ETR		MTR	
	Alternative 2	Alternative 4	Alternative 2	Alternative 4
Th-229	No	No	No	No
Th-230	No	No	No	No
Th-232	No	No	No	No
U-232	No	No	No	No
U-233	No	No	No	No
U-234	No	No	No	No
U-235	No	No	No	No
U-236	No	No	No	No
U-238	No	No	No	No
Zn-65	No	No	No	No

a. "Yes" indicates that the contaminant remains a concern, and "No" indicates that it is no longer a concern.

ETR = Engineering Test Reactor

MTR = Materials Testing Reactor

4. INITIAL SCREENING OF NONRADIONUCLIDES

For nonradionuclides, the concentrations provided in Table B-3 of EDF-6482 were used. The initial screening tables are presented in Appendix A. A results summary for the initial screening of the nonradionuclides is presented in Table 2. For ETR Alternatives 2 and 4, the soil concentrations of chromium, copper, nickel, and silver all exceed the EBSLs. For MTR Alternative 2, the soil concentrations of barium, beryllium, boron, chromium, copper, and nickel all exceed the EBSLs. For MTR Alternative 4, the soil concentrations of boron, chromium, copper, and nickel all exceed the EBSLs. These nonradionuclides will be further assessed in the following section.

Table 2. Results of nonradionuclide screening (concentrations from EDF-6482) against ecological soil screening levels.

	ETR		MTR	
	Alternative 2	Alternative 4	Alternative 2	Alternative 4
<u>Organics</u>				
Aroclor-1254	NA	NA	No	NA
<u>Inorganics</u>				
Aluminum	No	NA	No	NA
Antimony	No	No	No	No
Barium	NA	NA	Yes	NA
Beryllium	NA	NA	Yes	NA
Boron	No	No	Yes	Yes
Cadmium	No	NA	NA	NA

Table 2. (continued).

	ETR		MTR	
	Alternative 2	Alternative 4	Alternative 2	Alternative 4
Chromium	Yes	Yes	Yes	Yes
Copper	Yes	Yes	Yes	Yes
Lead	No	No	No	No
Manganese	No	No	No	No
Nickel	Yes	Yes	Yes	Yes
Silver	Yes	Yes	No	No
Tin	No	No	No	No
Zinc	No	No	No	No

a. "Yes" indicates that the contaminant remains a concern, and "No" indicates that it is no longer a concern.

ETR = Engineering Test Reactor

MTR = Materials Testing Reactor

NA = not applicable. The contaminant was not present in the alternative.

5. FURTHER EVALUATION OF NONRADIONUCLIDES

Several nonradionuclides had contaminants modeled as having soil concentrations above screening levels. Hazard quotients (HQs) and hazard indices (HIs) were calculated for these nonradionuclides using the approach documented in the *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Groups 6 and 10 Operable Unit 10-04* (DOE-ID 2001). Changes based on the new or updated chemical-specific documents from the EPA (<http://www.epa.gov/ecotox/ecoss1/recent.htm>) were included for antimony, arsenic, barium, beryllium, cadmium, chromium (no value is now recommended for exposure to plants), cobalt, lead, and vanadium. In addition, nickel, copper, and chromium (total) uptake values were updated for the soil-to-invertebrate bioaccumulation factors provided by the EPA (EPA 1999). By using a less conservative value (than the 1.0 previously used), a more realistic exposure assessment could be developed. This impacted the selected insectivores in the assessment, including the sage sparrow, burrowing owl, and deer mouse.

Using this approach, an HQ was developed for each contaminant by dividing the maximum calculated dose by its toxicity value. The HQs are then summed across species to develop an HI. At the INL, it is accepted that, if the total HI does not exceed 10, then the contaminants remaining can be eliminated for risk to ecological receptors at the population level.

5.1 Engineering Test Reactor Alternatives 2 and 4

Since all the nonradionuclides are at the same concentrations in both ETR Alternatives 2 and 4, they are presented together. Table 3 presents the calculated dose and Table 4 presents the calculated HQs and HIs. As can be seen from Table 4, the HIs for the deer mouse, the pygmy rabbit, and plants are greater than 10. This is primarily due to the contribution of the metal copper. The modeling for the metals remaining after closure of this site is highly conservative. The concentrations were calculated by assuming that all the metal (e.g., part of reactors and wiring piping) would be uniformly mixed throughout the soil. This mixture would then be in a chemical form that would be bioavailable to receptors using the area. For example, of the estimated 36,840 kg of copper that would remain at the

ETR facility, 34,019 kg is copper wiring. Similar modeling was performed to determine the concentration of chromium that might be present in the soil. Chromium is not known to exist in significant quantities within the ETR facilities other than in an alloyed form, principally as a major alloy in stainless-steel components (EDF-6225). Of the total estimated quantity of chromium (35,420 kg) in the ETR Complex, 32,872 kg is estimated to be part of the stainless steel that would be left within the buried facility. It is highly unlikely that either copper or chromium would be in a bioavailable form for exposure and uptake by ecological receptors.

Table 3. Nonradionuclide calculated dose for Engineering Test Reactor Alternatives 2 and 4 (0.425 hectares for site size [EDF-6482]).

Concentration	Chromium	Copper	Nickel	Silver
Concentration in surface soil (mg/kg)	1.85E+03	1.93E+03	1.03E+03	2.09E+00
Dose (mg/kg-d)				
Species	Chromium	Copper	Nickel	Silver
Great Basin spadefoot toad	1.03E+00	1.51E+00	8.35E+00	7.38E-03
Mourning dove	1.81E+00	7.65E+00	3.53E-01	4.19E-03
Sage sparrow	8.02E+00	1.06E+01	4.86E+00	4.05E-02
Ferruginous hawk	1.07E-02	1.54E-03	2.17E-03	2.30E-05
Loggerhead shrike	4.07E+00	5.86E-01	8.27E-01	8.78E-03
Burrowing owl	8.11E-01	2.60E-01	1.78E-01	1.71E-03
Black-billed magpie	1.51E+00	3.30E+00	2.21E+00	3.41E-03
Mule deer	5.66E-01	2.30E+00	1.20E-01	1.28E-03
Pygmy rabbit	4.15E+01	1.69E+02	8.84E+00	9.37E-02
Townsend's western big-eared bat	4.92E+00	3.67E+00	1.18E+00	3.25E-02
Coyote	1.10E-03	1.94E-04	2.37E-04	2.33E-06
Deer mouse	6.31E+01	1.35E+02	9.86E+00	1.39E-01
Sagebrush lizard	7.57E-01	6.03E-01	5.10E+00	4.29E-03
Plants	3.52E+02	1.54E+03	6.18E+01	8.36E-01
Soil invertebrates	NA	NA	NA	NA

NA = not applicable

Table 4. Nonradionuclide hazard quotients and indices for Engineering Test Reactor Alternatives 2 and 4 (bolded items exceed the hazard quotient or hazard index of 10).

Species	Hazard Quotient (unitless)					ETR Alternatives 2 and 4
	Chromium ^a	Copper	Nickel	Silver		
Great Basin spadefoot toad	NA	NA	NA	NA	—	—
Mourning dove	6.8E-01	1.7E+00	4.0E-02	2.9E-04	2.4	2.4
Sage sparrow	3.0E+00	2.3E+00	8.3E-01	2.8E-03	6.2	6.2
Ferruginous hawk	4.0E-03	3.3E-04	3.7E-04	1.6E-06	0.0	0.0
Loggerhead shrike	1.5E+00	1.3E-01	1.4E-01	6.0E-04	1.8	1.8
Burrowing owl	3.0E-01	5.6E-02	3.0E-02	1.2E-04	0.4	0.4
Black-billed magpie	5.7E-01	4.8E-01	3.8E-01	1.6E-04	1.4	1.4
Mule deer	2.4E-01	3.5E+00	6.3E-03	1.1E-04	3.8	3.8
Pygmy rabbit	1.7E+01	2.6E+02	4.7E-01	8.3E-03	280	280
Townsend's western big-eared bat	2.1E+00	5.6E+00	6.2E-02	2.9E-03	7.8	7.8
Coyote	4.6E-04	1.0E-04	1.2E-05	2.1E-07	0.0	0.0
Deer mouse	2.6E+01	2.1E+02	3.5E-01	8.2E-03	240	240
Sagebrush lizard	NA	NA	NA	NA	0.0	0.0
Plants	NA	1.5E+01	2.1E+00	4.2E-01	17	17
Soil invertebrates	NA	NA	NA	NA	NA	NA

a. Chromium was assessed as Chromium III.

ETR = Engineering Test Reactor

NA = not applicable. No toxicity data were available for the evaluation.

5.2 Materials Testing Reactor Alternatives 2 and 4

Since all the nonradionuclides except for barium and beryllium are at the same concentrations in both MTR Alternatives 2 and 4, they are presented together. Table 5 presents the calculated dose and Table 6 presents the calculated HQs and HIs. As can be seen from Table 6, the HIs for the deer mouse, the pygmy rabbit, and plants are greater than 10. This is primarily due to the contribution of the metal copper. The modeling for the metals remaining after closure of this site is highly conservative. The concentrations were calculated by assuming that all the metal (e.g., part of reactors and wiring piping) would be uniformly mixed throughout the soil. This mixture would then be in a chemical form that would be bioavailable to receptors using the area. For example, of the estimated 339,110 kg of copper that would remain at the MTR facility, 34,020 kg is copper wiring and 2,270 kg is switchgear (EDF-6244). Similar modeling was performed to determine the concentration of chromium that might be present in the soil. Chromium is not known to exist in significant quantities within the MTR facilities other than in an alloyed form, principally as a major alloy in stainless-steel components (EDF-6244). Of the total estimated quantity of chromium (18,770 kg) in the MTR Complex, 15,219 kg is estimated to be part of the stainless steel that would be left within the buried facility. It is highly unlikely that either copper or chromium would be in a bioavailable form for exposure and uptake by ecological receptors.

6. COPPER AND CHROMIUM DISCUSSION

As can be seen in Tables 4 and 6, the modeled concentrations of both copper and chromium are presenting possible risk to ecological receptors. Based on the modeling used, receptors would be exposed to these concentrations in the future after the degradation of the cap. Because of the extremely conservative assumptions made in the development of the concentrations of metals remaining at both the ETR and MTR, it is unlikely that these concentrations will be seen at these sites. It is assumed that all the possible sources of these metals (including piping, wiring, and stainless-steel structures from the surface to 38 ft below ground surface) are bioavailable. First, not all of these metals would be in a depth range that ecological receptors could reach. Second, the risk assessment uses a toxicity value based on compounds of these metals. In the case of copper, toxicity is tested most commonly using CuSO₄ and CuEDTA, while chromium toxicity is tested most commonly using K₂CrO₄, Na₂Cr₄, and CrCl₃. Finally, as discussed below, these metals will not be easily degraded to the highly bioavailable forms of these contaminants.

For conservatism, the model assumed that copper metal (primarily in the form of wire and piping) will corrode and be uniformly spread throughout the soils within the area. Corrosion is fundamentally a return of metals to their native state as oxides and salts. Only noble metals and copper exist in nature in their metallic state. Copper in the metallic form is insoluble to water and therefore is likely to remain in the environment in this form. It is unlikely that copper concentrations in soil will pose a risk to ecological receptors.

Similar to copper, chromium was modeled as being present from the corrosion of stainless steel remaining at the site. It is the addition of a minimum of 12% of chromium to the steel that makes it resist rust or stain less than other types of steel (the stainless steel that will remain is assumed to be 304 type, which on average contains 19% chromium [EDF-6224 and EDF-6225]). The chromium in the steel combines with oxygen in the atmosphere to form a thin, invisible layer of chrome-containing oxide, called the passive film. The sizes of chromium atoms and their oxides are similar; thus, they pack neatly together on the surface of the metal, forming a stable layer only a few atoms thick. If the metal is cut or scratched and the passive film is disrupted, more oxide will quickly form and recover the exposed surface, protecting it from oxidative corrosion. The passive film requires oxygen to self-repair, so stainless steels

Table 5. Nonradiouclide calculated dose for Materials Testing Reactor Alternatives 2 and 4 (0.707 hectares for site size [EDF-6482]).

Concentration	Barium	Beryllium	Boron	Chromium	Copper	Nickel
Concentration in surface soil (mg/kg)	1.38E+04	6.76E+01	4.40E+00	5.90E+02	1.23E+03	3.49E+02
Dose (mg/kg-d)						
Species	Barium	Beryllium	Boron	Chromium	Copper	Nickel
Great Basin spadefoot toad	1.12E+02	3.75E-02	2.13E-03	3.27E-01	9.64E-01	2.83E+00
Mourning dove	1.80E+01	1.11E-02	3.61E-02	9.60E-01	8.10E+00	1.99E-01
Sage sparrow	9.75E+02	4.88E-01	2.91E-02	4.26E+00	1.12E+01	2.74E+00
Ferruginous hawk	1.02E-01	8.94E-05	4.06E-06	5.66E-03	1.63E-03	1.22E-03
Loggerhead shrike	3.91E+01	3.41E-02	1.55E-03	2.16E+00	6.21E-01	4.66E-01
Burrowing owl	7.88E+00	8.74E-03	4.41E-04	4.30E-01	2.75E-01	1.00E-01
Black-billed magpie	5.34E+01	8.99E-03	1.49E-02	8.01E-01	3.50E+00	1.25E+00
Mule deer	5.68E+00	4.97E-03	1.09E-02	3.00E-01	2.44E+00	6.78E-02
Pygmy rabbit	2.51E+02	2.19E-01	4.79E-01	1.32E+01	1.08E+02	2.99E+00
Townsend's western big-eared bat	8.80E+02	8.58E-02	3.03E-03	2.61E+00	3.89E+00	6.63E-01
Coyote	1.06E-02	1.13E-05	5.62E-07	5.83E-04	2.06E-04	1.34E-04
Deer mouse	1.30E+03	3.26E-01	3.63E-01	2.01E+01	8.58E+01	3.34E+00
Sagebrush lizard	6.84E+01	1.13E-02	5.40E-04	2.41E-01	3.84E-01	1.73E+00
Plants	2.07E+03	6.76E-01	4.40E+00	1.12E+02	9.84E+02	2.09E+01
Soil invertebrates	NA	NA	NA	NA	NA	NA

NA = not applicable

Table 6. Nonradioactive hazard quotients and indices for Materials Testing Reactor Alternatives 2 and 4 (bolded items exceed the hazard quotient or hazard index of 10).

Species	Hazard Quotient (unitless)						MTR Alternative 2	MTR Alternative 4
	Barium ^a	Beryllium ^a	Boron	Chromium ^b	Copper	Nickel		
Great Basin spadefoot toad	NA	NA	NA	NA	NA	NA	NA	NA
Mourning dove	NA	NA	2.5E-03	3.6E-01	1.8E+00	2.3E-02	2.2	2.2
Sage sparrow	NA	NA	3.0E-03	1.6E+00	2.4E+00	4.7E-01	4.5	4.5
Ferruginous hawk	NA	NA	4.2E-07	2.1E-03	3.5E-04	2.1E-04	0.0	0.0
Loggerhead shrike	NA	NA	1.6E-04	8.1E-01	1.3E-01	8.0E-02	1.0	1.0
Burrowing owl	NA	NA	4.6E-05	1.6E-01	6.0E-02	1.7E-02	0.2	0.2
Black-billed magpie	NA	NA	1.5E-03	3.0E-01	5.1E-01	2.1E-01	1.0	1.0
Mule deer	2.8E-03	2.4E-04	3.7E-03	1.3E-01	3.8E+00	3.6E-03	3.9	3.9
Pygmy rabbit	1.3E-01	1.0E-02	1.6E-01	5.5E+00	1.7E+02	1.6E-01	170	170
Townsend's western big-eared bat	4.4E-01	4.1E-03	1.0E-03	1.1E+00	6.0E+00	3.5E-02	7.6	7.2
Coyote	5.3E-06	5.4E-07	1.9E-07	2.4E-04	1.1E-04	7.0E-06	0.0	0.0
Deer mouse	6.5E-01	1.6E-02	8.3E-02	8.4E+00	1.3E+02	1.2E-01	140	140
Sagebrush lizard	NA	NA	NA	NA	NA	NA	NA	NA
Plants	NA	NA	8.8E+00	NA	9.8E+00	7.0E-01	18	18
Soil invertebrates	NA	NA	NA	NA	NA	NA	NA	NA

a. Barium and beryllium were not presented in MTR Alternative 4.

b. Chromium was assessed as Chromium III.

MTR = Materials Testing Reactor

NA = not applicable. No toxicity date were available for the evaluation.

have poor corrosion resistance in low-oxygen and poor-circulation environments. In seawater, chlorides from the salt will attack and destroy the passive film more quickly than it can be repaired in a low-oxygen environment (<http://chemistry.about.com/cs/metalsandalloys/a/aa071201a.htm>). Therefore, the stainless steel remaining at the site will not degrade as modeled. It is unlikely that chromium concentrations from degradation of the stainless steel will pose a risk to ecological receptors.

7. SUMMARY

To support the closure alternatives at the ETR and MTR, an evaluation of the ecological risk was performed. This evaluation used a screening approach to evaluate risk to ecological receptors. The screening for radionuclides indicates that EBSLs are exceeded for Co-60 and Ni-63 for ETR Alternative 2 and for Co-60 for MTR Alternative 2. No radionuclide concentrations exceed EBSLs for Alternative 4 at either location.

The nonradionuclides were evaluated and many of the metal concentrations at both locations for both alternatives exceed the EBSLs. Further evaluation indicates that both chromium and copper for both alternatives at ETR and MTR exceed HIs of 10. However, the EDFs used to develop the nonradiological contaminant inventories associated with the ETR and MTR were reviewed. They indicate that grade structures and systems (including piping, wiring, stainless steel, and utility systems) were included in the source-term development (EDF-6225, EDF-6244). As discussed, the inclusion of these items in the overall soil concentration is a highly conservative assumption. In the environment at this site, items such as wiring, piping, and large stainless-steel equipment pieces will not degrade to a bioavailable form uniformly throughout this soil as was modeled. It is also assumed that all the contents of the building to 38 ft below ground are included. Therefore, any concentration of concern would be highly localized and it is unlikely that it would pose a risk to ecological receptors at a population level. Therefore, the nonradionuclides also are eliminated as a concern. Please refer to Appendix A for the ecological screening tables.

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Appendix A

Ecological Screening Tables

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Appendix A

Ecological Screening Tables

Table A-1. Initial ecological risk screening for Engineering Test Reactor Alternative 2.

Radionuclide	Contaminants	Maximum Source Concentration (mg/kg or pCi/g)	Background Concentration (mg/kg or pCi/g)	Maximum Concentration >background?	Nontoxic Metal?	Screening Value (mg/kg or pCi/g)	Maximum Concentration >screening values?	Ecological Concern?
Ac-227		5.28E-05	NA	NA	No	2.04E+05	No	No
Ag-108m		1.27E+01	NA	NA	No	1.82E+03	No	No
Ag-110m		3.87E-09	NA	NA	No	1.08E+03	No	No
Am-241		9.51E+00	1.10E-02	Yes	No	1.78E+01	No	No
Am-243		1.44E-01	NA	NA	No	1.85E+01	No	No
Be-10		1.95E+01	NA	NA	No	9.63E+03	No	No
C-14		6.95E+02	NA	NA	No	3.94E+04	No	No
Ce-144		1.18E-07	NA	NA	No	2.27E+04	No	No
Cl-36		6.59E+00	NA	NA	No	7.84E+03	No	No
Cm-243		2.63E-02	NA	NA	No	1.68E+01	No	No
Cm-244		1.67E+01	NA	NA	No	1.68E+01	No	No
Cm-245		3.16E-03	NA	NA	No	1.68E+01	No	No
Cm-246		3.49E-03	NA	NA	No	1.68E+01	No	No
Cm-247		2.46E-08	NA	NA	No	1.68E+01	No	No
Cm-248		4.42E-07	NA	NA	No	2.10E+01	No	No
Co-60		1.03E+05	NA	NA	No	1.18E+03	Yes	Yes
Cs-134		1.54E-01	NA	NA	No	1.90E+03	No	No
Cs-137		1.44E+02	8.20E-01	Yes	No	4.95E+03	No	No
Eu-152		9.51E+00	NA	NA	No	2.18E+03	No	No
Eu-154		5.49E+01	NA	NA	No	2.48E+03	No	No
Eu-155		0.00E+00	NA	NA	No	3.25E+04	No	No
Fe-55		8.68E+00	NA	NA	No	2.01E+06	No	No

Table A-1. (continued).

Contaminants	Maximum Source Concentration (mg/kg or pCi/g)	Background Concentration (mg/kg or pCi/g)	Maximum Concentration >background?	Nontoxic Metal?	Screening Value (mg/kg or pCi/g)	Maximum Concentration >screening values?	Ecological Concern?
H-3	1.72E+06	NA	NA	No	3.43E+05	Yes	Yes
I-129	1.38E-03	NA	NA	No	4.76E+04	No	No
Mn-54	1.68E-04	NA	NA	No	3.53E+03	No	No
Nb-94	2.52E+02	NA	NA	No	1.87E+03	No	No
Nb-95	0.00E+00	NA	NA	No	3.56E+03	No	No
Ni-59	6.90E+03	NA	NA	No	1.24E+06	No	No
Ni-63	1.27E+06	NA	NA	No	1.14E+05	Yes	Yes
Np-237	1.12E-04	NA	NA	No	1.94E+01	No	No
Pa-231	7.74E-05	NA	NA	No	2.37E+01	No	No
Pb-210	3.60E-09	NA	NA	No	2.74E+05	No	No
Pu-238	4.38E+00	4.90E-03	Yes	No	1.78E+01	No	No
Pu-239	9.54E-01	1.00E-01	Yes	No	1.89E+01	No	No
Pu-240	1.17E+00	1.00E-01	Yes	No	1.89E+01	No	No
Pu-241	9.51E+01	NA	NA	No	3.73E+05	No	No
Pu-242	1.48E-02	NA	NA	No	2.00E+01	No	No
Pu-244	1.40E-08	NA	NA	No	2.12E+01	No	No
Ra-226	5.80E-09	NA	NA	No	2.04E+01	No	No
Ru-106	1.64E-05	NA	NA	No	1.94E+05	No	No
Sb-125	3.45E-01	NA	NA	No	6.02E+03	No	No
Sr-90	4.44E+01	4.90E-01	Yes	No	3.34E+03	No	No
Tc-99	3.33E-01	NA	NA	No	1.60E+04	No	No
Th-228	9.36E-03	1.60E+00	No	No	1.81E+01	No	No
Th-229	6.27E-05	NA	NA	No	3.60E+01	No	No
Th-230	6.12E-07	1.41E+00	No	No	2.09E+01	No	No
Th-232	1.07E-04	1.60E+00	No	No	2.43E+01	No	No
U-232	9.04E-03	NA	NA	No	1.54E+01	No	No
U-233	1.83E-02	NA	NA	No	2.05E+01	No	No

Table A-1. (continued).

Contaminants	Maximum Source Concentration (mg/kg or pCi/g)	Background Concentration (mg/kg or pCi/g)	Maximum Concentration >background?	Nontoxic Metal?	Screening Value (mg/kg or pCi/g)	Maximum Concentration >screening values?	Ecological Concern?
U-234	1.60E-03	1.44E+00	No	No	2.05E+01	No	No
U-235	2.36E-05	NA	NA	No	2.27E+01	No	No
U-236	3.78E-05	NA	NA	No	2.17E+01	No	No
U-238	5.85E-04	1.40E+00	No	No	2.32E+01	No	No
Zn-65	8.94E-09	NA	NA	No	5.21E+03	No	No
Nonradionuclide							
Aroclor-1254	0.00E+00	NA	NA	No	1.66E-01	No	No
Aluminum	1.75E+02	1.60E+04	No	Yes	5.00E+01	Yes	No
Antimony	3.14E-02	4.80E+00	No	No	2.70E-01	No	No
Barium	0.00E+00	3.00E+02	No	No	3.30E+02	No	No
Beryllium	0.00E+00	1.80E+00	No	No	2.10E+01	No	No
Boron	2.61E-02	NA	NA	No	5.00E-01	No	No
Cadmium	4.18E-01	2.20E+00	No	No	3.60E-01	Yes	No
Chromium	1.85E+03	3.30E+01	Yes	No	2.60E+01	Yes	Yes
Copper	1.93E+03	2.20E+01	Yes	No	4.00E+01	Yes	Yes
Lead	2.09E+00	1.70E+01	No	No	1.10E+01	No	No
Manganese	4.01E+02	4.90E+02	No	No	1.05E+01	Yes	No
Nickel	1.03E+03	3.50E+01	Yes	No	3.00E+01	Yes	Yes
Silver	2.09E+00	NA	NA	No	2.00E+00	Yes	Yes
Tin	4.18E+00	NA	NA	No	5.30E+01	No	No
Zinc	3.87E+01	1.50E+02	No	No	5.00E+01	No	No

NA = not applicable

Table A-2. Initial ecological risk screening for Engineering Test Reactor Alternative 4.

Radionuclide	Contaminants	Maximum Source Concentration (mg/kg or pCi/g)	Background Concentration (mg/kg or pCi/g)	Maximum Concentration >background?	Nontoxic Metal?	Screening Value (mg/kg or pCi/g)	Maximum Concentration >screening values?	Ecological Concern?
Ac-227		0.00E+00	NA	NA	NA	2.04E+05	No	No
Ag-108m		5.19E-03	NA	NA	NA	1.82E+03	No	No
Ag-110m		0.00E+00	NA	NA	NA	1.08E+03	No	No
Am-241		2.78E-03	1.10E-02	No	No	1.78E+01	No	No
Am-243		0.00E+00	NA	NA	NA	1.85E+01	No	No
Be-10		0.00E+00	NA	NA	NA	9.63E+03	No	No
C-14		2.74E-02	NA	NA	NA	3.94E+04	No	No
Ce-144		0.00E+00	NA	NA	NA	2.27E+04	No	No
Cl-36		0.00E+00	NA	NA	NA	7.84E+03	No	No
Cm-243		0.00E+00	NA	NA	NA	1.68E+01	No	No
Cm-244		0.00E+00	NA	NA	NA	1.68E+01	No	No
Cm-245		0.00E+00	NA	NA	NA	1.68E+01	No	No
Cm-246		0.00E+00	NA	NA	NA	1.68E+01	No	No
Cm-247		0.00E+00	NA	NA	NA	1.68E+01	No	No
Cm-248		0.00E+00	NA	NA	NA	2.10E+01	No	No
Co-60		6.27E+00	NA	NA	NA	1.18E+03	No	No
Cs-134		0.00E+00	NA	NA	NA	1.90E+03	No	No
Cs-137		2.42E+00	8.20E-01	Yes	NA	4.95E+03	No	No
Eu-152		0.00E+00	NA	NA	NA	2.18E+03	No	No
Eu-154		0.00E+00	NA	NA	NA	2.48E+03	No	No
Eu-155		0.00E+00	NA	NA	NA	3.25E+04	No	No
Fe-55		8.00E+00	NA	NA	NA	2.01E+06	No	No
H-3		0.00E+00	NA	NA	NA	3.43E+05	No	No
I-129		1.17E-03	NA	NA	NA	4.76E+04	No	No
Mn-54		0.00E+00	NA	NA	NA	3.53E+03	No	No
Nb-94		0.00E+00	NA	NA	NA	1.87E+03	No	No

Table A-2. (continued).

Contaminants	Maximum Source Concentration (mg/kg or pCi/g)	Background Concentration (mg/kg or pCi/g)	Maximum Concentration >background?	Nontoxic Metal?	Screening Value (mg/kg or pCi/g)	Maximum Concentration >screening values?	Ecological Concern?
Nb-95	0.00E+00	NA	NA	No	3.56E+03	No	No
Ni-59	1.50E-01	NA	NA	No	1.24E+06	No	No
Ni-63	1.45E+01	NA	NA	No	1.14E+05	No	No
Np-237	0.00E+00	NA	NA	No	1.94E+01	No	No
Pa-231	0.00E+00	NA	NA	No	2.37E+01	No	No
Pb-210	0.00E+00	NA	NA	No	2.74E+05	No	No
Pu-238	2.81E-03	4.90E-03	No	No	1.78E+01	No	No
Pu-239	5.54E-03	1.00E-01	No	No	1.89E+01	No	No
Pu-240	0.00E+00	1.00E-01	No	No	1.89E+01	No	No
Pu-241	2.19E-02	NA	NA	No	3.73E+05	No	No
Pu-242	0.00E+00	NA	NA	No	2.00E+01	No	No
Pu-244	0.00E+00	NA	NA	No	2.12E+01	No	No
Ra-226	0.00E+00	NA	NA	No	2.04E+01	No	No
Ru-106	0.00E+00	NA	NA	No	1.94E+05	No	No
Sb-125	0.00E+00	NA	NA	No	6.02E+03	No	No
Sr-90	2.19E-01	4.90E-01	No	No	3.34E+03	No	No
Tc-99	1.79E-03	NA	NA	No	1.60E+04	No	No
Th-228	0.00E+00	1.60E+00	No	No	1.81E+01	No	No
Th-229	0.00E+00	NA	NA	No	3.60E+01	No	No
Th-230	0.00E+00	1.41E+00	No	No	2.09E+01	No	No
Th-232	0.00E+00	1.60E+00	No	No	2.43E+01	No	No
U-232	0.00E+00	NA	NA	No	1.54E+01	No	No
U-233	4.40E-04	NA	NA	No	2.05E+01	No	No
U-234	0.00E+00	1.44E+00	No	No	2.05E+01	No	No
U-235	9.51E-06	NA	NA	No	2.27E+01	No	No
U-236	0.00E+00	NA	NA	No	2.17E+01	No	No
U-238	1.40E-04	1.40E+00	No	No	2.32E+01	No	No
Zn-65	0.00E+00	NA	NA	No	5.21E+03	No	No

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Table A-2. (continued).

Contaminants	Maximum Source Concentration (mg/kg or pCi/g)	Background Concentration (mg/kg or pCi/g)	Maximum Concentration >background?	Nontoxic Metal?	Screening Value (mg/kg or pCi/g)	Maximum Concentration >screening values?	Ecological Concern?
Nonradionuclide							
Aroclor-1254	0.00E+00	NA	NA	No	1.66E-01	No	No
Aluminum	0.00E+00	1.60E+04	No	Yes	5.00E+01	No	No
Antimony	3.14E-02	4.80E+00	No	No	2.70E-01	No	No
Barium	0.00E+00	3.00E+02	No	No	3.30E+02	No	No
Beryllium	0.00E+00	1.80E+00	No	No	2.10E+01	No	No
Boron	2.61E-02	NA	NA	No	5.00E-01	No	No
Cadmium	0.00E+00	2.20E+00	No	No	3.60E-01	No	No
Chromium	1.85E+03	3.30E+01	Yes	No	2.60E+01	Yes	Yes
Copper	1.93E+03	2.20E+01	Yes	No	4.00E+01	Yes	Yes
Lead	2.09E+00	1.70E+01	No	No	1.10E+01	No	No
Manganese	4.01E+02	4.90E+02	No	No	1.05E+01	Yes	No
Nickel	1.03E+03	3.50E+01	Yes	No	3.00E+01	Yes	Yes
Silver	2.09E+00	NA	NA	No	2.00E+00	Yes	Yes
Tin	4.18E+00	NA	NA	No	5.30E+01	No	No
Zinc	3.87E+01	1.50E+02	No	No	5.00E+01	No	No

NA = not applicable

Table A-3. Initial ecological risk screening for Materials Testing Reactor Alternative 2.

Radionuclides	Contaminants	Maximum Source Concentration (mg/kg or pCi/g)	Background Concentration (mg/kg or pCi/g)	Maximum Concentration >background?	Nontoxic Metal?	Screening Value (mg/kg or pCi/g)	Maximum Concentration >screening values?	Ecological Concern?
Ac-227		1.50E-05	NA	NA	NA	2.04E+05	No	No
Ag-108m		5.06E+00	NA	NA	No	1.82E+03	No	No
Ag-110m		1.51E-13	NA	NA	No	1.08E+03	No	No
Am-241		2.87E+00	1.10E-02	Yes	No	1.78E+01	No	No
Am-243		2.08E-03	NA	NA	No	1.85E+01	No	No
Be-10		1.76E+00	NA	NA	No	9.63E+03	No	No
C-14		1.04E+02	NA	NA	No	3.94E+04	No	No
Ce-144		1.79E-02	NA	NA	No	2.27E+04	No	No
Cl-36		1.01E+00	NA	NA	No	7.84E+03	No	No
Cm-243		1.46E-03	NA	NA	No	1.68E+01	No	No
Cm-244		4.06E-02	NA	NA	No	1.68E+01	No	No
Cm-245		5.56E-06	NA	NA	No	1.68E+01	No	No
Cm-246		9.74E-07	NA	NA	No	1.68E+01	No	No
Cm-247		1.26E-12	NA	NA	No	1.68E+01	No	No
Cm-248		1.51E-12	NA	NA	No	2.10E+01	No	No
Co-60		1.91E+03	NA	NA	No	1.18E+03	Yes	Yes
Cs-134		7.42E-02	NA	NA	No	1.90E+03	No	No
Cs-137		2.30E+01	8.20E-01	Yes	No	4.95E+03	No	No
Eu-152		1.78E+02	NA	NA	No	2.18E+03	No	No
Eu-154		3.21E+01	NA	NA	No	2.48E+03	No	No
Eu-155		2.99E-03	NA	NA	No	3.25E+04	No	No
Fe-55		1.89E-04	NA	NA	No	2.01E+06	No	No
H-3		6.98E+03	NA	NA	No	3.43E+05	No	No
I-129		1.92E-02	NA	NA	No	4.76E+04	No	No
Mn-54		6.50E-09	NA	NA	No	3.53E+03	No	No
Nb-94		1.67E+00	NA	NA	No	1.87E+03	No	No

Table A-3. (continued).

Contaminants	Maximum Source Concentration (mg/kg or pCi/g)	Background Concentration (mg/kg or pCi/g)	Maximum Concentration >background?	Nontoxic Metal?	Screening Value (mg/kg or pCi/g)	Maximum Concentration >screening values?	Ecological Concern?
Nb-95	1.33E-04	NA	NA	No	3.56E+03	No	No
Ni-59	1.42E+02	NA	NA	No	1.24E+06	No	No
Ni-63	1.47E+04	NA	NA	No	1.14E+05	No	No
Np-237	3.24E-05	NA	NA	No	1.94E+01	No	No
Pa-231	2.02E-05	NA	NA	No	2.37E+01	No	No
Pb-210	5.97E-09	NA	NA	No	2.74E+05	No	No
Pu-238	2.63E+00	4.90E-03	Yes	No	1.78E+01	No	No
Pu-239	5.77E+00	1.00E-01	Yes	No	1.89E+01	No	No
Pu-240	2.13E+00	1.00E-01	Yes	No	1.89E+01	No	No
Pu-241	1.29E+01	NA	NA	No	3.73E+05	No	No
Pu-242	6.54E-04	NA	NA	No	2.00E+01	No	No
Pu-244	1.18E-11	NA	NA	No	2.12E+01	No	No
Ra-226	1.61E-08	NA	NA	No	2.04E+01	No	No
Ru-106	3.01E-09	NA	NA	No	1.94E+05	No	No
Sb-125	1.18E-02	NA	NA	No	6.02E+03	No	No
Sr-90	1.35E+01	4.90E-01	Yes	No	3.34E+03	No	No
Tc-99	1.13E-01	NA	NA	No	1.60E+04	No	No
Th-228	1.43E-03	1.60E+00	No	No	1.81E+01	No	No
Th-229	2.26E-05	NA	NA	No	3.60E+01	No	No
Th-230	1.49E-06	1.41E+00	No	No	2.09E+01	No	No
Th-232	1.04E-03	1.60E+00	No	No	2.43E+01	No	No
U-232	4.01E-04	NA	NA	No	1.54E+01	No	No
U-233	5.53E-03	NA	NA	No	2.05E+01	No	No
U-234	3.80E-03	1.44E+00	No	No	2.05E+01	No	No
U-235	1.48E-04	NA	NA	No	2.27E+01	No	No
U-236	3.08E-05	NA	NA	No	2.17E+01	No	No
U-238	3.28E-03	1.40E+00	No	No	2.32E+01	No	No
Zn-65	9.99E-05	NA	NA	No	5.21E+03	No	No

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Table A-3. (continued).

Contaminants	Maximum Source Concentration (mg/kg or pCi/g)	Background Concentration (mg/kg or pCi/g)	Maximum Concentration >background?	Nontoxic Metal?	Screening Value (mg/kg or pCi/g)	Maximum Concentration >screening values?	Ecological Concern?
Nonradionuclides							
Aroclor-1254	6.28E-04	NA	NA	No	1.66E-01	No	No
Aluminum	3.95E+02	1.60E+04	No	Yes	5.00E+01	Yes	No
Antimony	1.89E-02	4.80E+00	No	No	2.70E-01	No	No
Barium	1.38E+04	3.00E+02	Yes	No	3.30E+02	Yes	Yes
Beryllium	6.76E+01	1.80E+00	Yes	No	2.10E+01	Yes	Yes
Boron	4.40E+00	NA	NA	No	5.00E-01	Yes	Yes
Cadmium	0.00E+00	2.20E+00	No	No	3.60E-01	No	No
Chromium	5.90E+02	3.30E+01	Yes	No	2.60E+01	Yes	Yes
Copper	1.23E+03	2.20E+01	Yes	No	4.00E+01	Yes	Yes
Lead	1.26E+00	1.70E+01	No	No	1.10E+01	No	No
Manganese	2.34E+02	4.90E+02	No	No	1.05E+01	Yes	No
Nickel	3.49E+02	3.50E+01	Yes	No	3.00E+01	Yes	Yes
Silver	1.26E+00	NA	NA	No	2.00E+00	No	No
Tin	2.51E+00	NA	NA	No	5.30E+01	No	No
Zinc	1.45E+01	1.50E+02	No	No	5.00E+01	No	No

NA = not applicable

Table A-4. Initial ecological risk screening for Materials Testing Reactor Alternative 4.

Radionuclides	Contaminants	Maximum Source Concentration (mg/kg or pCi/g)	Background Concentration (mg/kg or pCi/g)	Maximum Concentration >background?	Nontoxic Metal?	Screening Value (mg/kg or pCi/g)	Maximum Concentration >screening values?	Ecological Concern?
Ac-227		0.00E+00	NA	NA	No	2.04E+05	No	No
Ag-108m		0.00E+00	NA	NA	No	1.82E+03	No	No
Ag-110m		0.00E+00	NA	NA	No	1.08E+03	No	No
Am-241		5.27E-01	1.10E-02	Yes	No	1.78E+01	No	No
Am-243		0.00E+00	NA	NA	No	1.85E+01	No	No
Be-10		0.00E+00	NA	NA	No	9.63E+03	No	No
C-14		3.38E-01	NA	NA	No	3.94E+04	No	No
Ce-144		1.79E-02	NA	NA	No	2.27E+04	No	No
Cl-36		0.00E+00	NA	NA	No	7.84E+03	No	No
Cm-243		0.00E+00	NA	NA	No	1.68E+01	No	No
Cm-244		1.96E-03	NA	NA	No	1.68E+01	No	No
Co-60		4.07E+00	NA	NA	No	1.18E+03	No	No
Cs-134		3.62E-02	NA	NA	No	1.90E+03	No	No
Cs-137		7.23E+00	8.20E-01	Yes	No	4.95E+03	No	No
Eu-152		9.72E-04	NA	NA	No	2.18E+03	No	No
Eu-154		6.48E-03	NA	NA	No	2.48E+03	No	No
Eu-155		2.99E-03	NA	NA	No	3.25E+04	No	No
Fe-55		1.89E-04	NA	NA	No	2.01E+06	No	No
H-3		0.00E+00	NA	NA	No	3.43E+05	No	No
I-129		1.24E-02	NA	NA	No	4.76E+04	No	No
Mn-54		0.00E+00	NA	NA	No	3.53E+03	No	No
Nb-94		0.00E+00	NA	NA	No	1.87E+03	No	No
Nb-95		1.33E-04	NA	NA	No	3.56E+03	No	No
Ni-59		1.89E-05	NA	NA	No	1.24E+06	No	No
Ni-63		2.08E-01	NA	NA	No	1.14E+05	No	No
Np-237		0.00E+00	NA	NA	No	1.94E+01	No	No

Table A-4. (continued).

Contaminants	Maximum Source Concentration (mg/kg or pCi/g)	Background Concentration (mg/kg or pCi/g)	Maximum Concentration >background?	Nontoxic Metal?	Screening Value (mg/kg or pCi/g)	Maximum Concentration >screening values?	Ecological Concern?
Pa-231	0.00E+00	NA	NA	No	2.37E+01	No	No
Pb-210	0.00E+00	NA	NA	No	2.74E+05	No	No
Pu-238	2.09E+00	4.90E-03	Yes	No	1.78E+01	No	No
Pu-239	4.57E+00	1.00E-01	Yes	No	1.89E+01	No	No
Pu-240	1.68E+00	1.00E-01	Yes	No	1.89E+01	No	No
Pu-241	0.00E+00	NA	NA	No	3.73E+05	No	No
Pu-242	0.00E+00	NA	NA	No	2.00E+01	No	No
Pu-244	0.00E+00	NA	NA	No	2.12E+01	No	No
Ra-226	0.00E+00	NA	NA	No	2.04E+01	No	No
Ru-106	0.00E+00	NA	NA	No	1.94E+05	No	No
Sb-125	1.76E-03	NA	NA	No	6.02E+03	No	No
Sr-90	7.25E+00	4.90E-01	Yes	No	3.34E+03	No	No
Tc-99	0.00E+00	NA	NA	No	1.60E+04	No	No
Th-228	0.00E+00	1.60E+00	No	No	1.81E+01	No	No
Th-229	0.00E+00	NA	NA	No	3.60E+01	No	No
Th-230	0.00E+00	1.41E+00	No	No	2.09E+01	No	No
Th-232	0.00E+00	1.60E+00	No	No	2.43E+01	No	No
U-232	1.78E-05	NA	NA	No	1.54E+01	No	No
U-233	0.00E+00	NA	NA	No	2.05E+01	No	No
U-234	4.10E-04	1.44E+00	No	No	2.05E+01	No	No
U-235	3.61E-06	NA	NA	No	2.27E+01	No	No
U-236	0.00E+00	NA	NA	No	2.17E+01	No	No
U-238	1.12E-05	1.40E+00	No	No	2.32E+01	No	No
Zn-65	9.99E-05	NA	NA	No	5.21E+03	No	No

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Table A-4. (continued).

Contaminants	Maximum Source Concentration (mg/kg or pCi/g)	Background Concentration (mg/kg or pCi/g)	Maximum Concentration >background?	Nontoxic Metal?	Screening Value (mg/kg or pCi/g)	Maximum Concentration >screening values?	Ecological Concern?
Nonradionuclides							
Aroclor-1254	0.00E+00	NA		No	1.66E-01	No	
Aluminum	0.00E+00	1.60E+04		Yes	5.00E+01	No	
Antimony	1.89E-02	4.80E+00		No	2.70E-01	No	
Barium	0.00E+00	3.00E+02		No	3.30E+02	No	
Beryllium	0.00E+00	1.80E+00		No	2.10E+01	No	
Boron	4.40E+00	NA		No	5.00E-01	Yes	Yes
Cadmium	0.00E+00	2.20E+00		No	3.60E-01	No	No
Chromium	5.90E+02	3.30E+01		Yes	No	2.60E+01	Yes
Copper	1.23E+03	2.20E+01		Yes	No	4.00E+01	Yes
Lead	1.26E+00	1.70E+01		No	1.10E+01	No	No
Manganese	2.34E+02	4.90E+02		No	No	1.05E+01	No
Nickel	3.49E+02	3.50E+01		Yes	No	3.00E+01	Yes
Silver	1.26E+00	NA		NA	No	2.00E+00	No
Tin	2.51E+00	NA		NA	No	5.30E+01	No
Zinc	1.45E+01	1.50E+02		No	No	5.00E+01	No

NA = not applicable